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Design, Development and Analysis of Bird Flight Diverter Mechanism using Unmanned Attachment Techniques

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***Abstract* - The electrocution and collision of birds with the overhead power transmission lines in Kachh district of Rajasthan is one of the major causes of death of the Great Indian Bustard and lesser florican. Aluminum conductors are hardly visible with Sun light in background. Bird Flight Diverters are identified as one of the measures to avoid the chances of collision of birds with transmission lines, hence reducing the mortality rate of these endangered species and shall be placed in identified stretches as per the guidelines of the Forest Authority. Attachment of these diverters is currently done manually which possess a high risk to the operator. Also power is to be cut from the lines before starting of installation. Attachment of diverters by drones is coming as an effective solution to the issues faced toady. Our aim is to design and develop such a mechanism that can be easily attached by drones within shortest time possible and would have minimal impact on drones on release. We also aim to differentiate the optimized material for the mechanism and perform impact analysis on it.**

Keywords: Bird flight diverter, Great Indian Bustard (GIB), Drones, mechanism, installation.

1. Introduction

The great Indian bustard (Ardeotis nigriceps) or Indian bustard is a bustard found in the Indian subcontinent. This large bird has a horizontal body and long bare legs like an ostrich, making him one of the heaviest birds in flight. The endemic bustard (GIB) is evolutionarily caught between open breeding and K-selection, threatening its survival amidst common levels of habitat loss and hunting [1]. Once common in the arid plains of the Indian subcontinent, as of 2018 it was estimated that only 150 individuals survived (down from an estimated 250 individuals in 2011), and the species is subject to hunting, electrocution, and habitat. Endangered due to loss of large dry meadows and shrubs. Protected by the Indian Wildlife Conservation Act 1972. [2]

The availability of electricity is an indicator of living standards. Electricity is transmitted from power plants to consumers mainly through overhead lines. This 'wiring' of the landscape continues to multiply around the world, penetrating even the most remote parts of the inhabited continents. Most of the power lines built to date pose mortal risks to numerous bird species and severely impair the habitats of large bird breeding, resting and wintering areas. Collisions with power lines are also a problem for utility companies due to the potential for power outages after the collision (impact electrocution) and the associated economic damage.

Collisions of birds with power lines are related to the main cause: the flying individual is unable to register such an obstacle ahead. Problems of collisions with power lines can be generally divided into three main categories based on factors of origin, including species specific factors, site specific factors and power line specific factors .The main reason for the frequent collisions of GIB with power lines is the evolution of their eyes with 3600 visibility for anti-predator vigilance comes at a trade-off of reduced frontal vision that is necessary to see the power-lines ahead while flying between habitats .Coupled with it, the heavy flight makes it difficult to man oeuvre wires when they are detected at the nick of the time. Most mortality happens in low-light conditions such as twilight, when birds fly between foraging and roosting grounds.

Even if collisions cannot be completely eliminated, they can be reduced by taking appropriate mitigation measures. Line marking is one of the best solutions because birds in flight rely on making the wire more conspicuous. This has become the preferred mitigation option worldwide. A wide range of his marking devices have evolved over the years, including bird balls, vibrating plates, spiral vibration dampers, strips, tapes, tapes, plates, flags and cross tapes. The effects of line drawing vary widely across studies, mainly with regard to habitat, bird species, season, power line type and configuration. Understanding the Nature of Bird Clashes is Essential to Minimizing Bird Clashes.

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In the past, large sheaves spiraling in confined areas were used to distract birds from living wires. This method has been shown to reduce mortality, but not by much. The Ministry of Environment, Forests and Climate Change (MoEFCC) has partnered with the Wildlife Conservation Society of India (WCS) to develop a unique initiative called 'Firefly Bird Diverters' for overhead lines in areas where the Bustard (GIB) is present. The firefly bird deflector is a damper installed on power lines. They act as reflectors for birds such as his GIB. According to WCS India's GIB Project Team Leader, the birds can spot them from about 50 meters away and change their trajectory to avoid colliding with power lines. The Firefly diverter is the first diverter installed in the country.

2. Measures

India's Supreme Court ruled in a recent public hearing that power lines within the GIB landscape should be buried. Experts said an innovative firefly deflection system could serve as an alternative to protection. Only his two regions of Jaisalmer and Bama in Rajasthan have breeding populations of his GIB in the wild, according to experts. This solution is very effective, but requires a certain amount of time, which endangered species do not. The Wildlife Conservation Society of India (WCSI) has installed his 1,848 bird deterrent devices on his 6.5 km high-voltage transmission line in Pokhran, Rajasthan. This is a more time-efficient solution to the initiative to protect the endangered Indian bustard from colliding with live power. line. Firefly bird deflectors are piloted on selected sections opposite the Pokhran Field Shooting Range, which provides a safe habitat for a breeding population of bustards outside the Desert National Park (DNP) sanctuary in Jaisalmer.

From a distance, the deflector looks like a series of fireflies perched on a wire. Basically, the diverter is a 6-inch-long, 4-inch-wide flap that clips onto the wire floating in the air.

These brackets rotate in the wind and are radio painted. They can be seen from about 50 meters away and have been confirmed by WCSI.

3. Installation Area

The firefly detectors were installed on two sections of approximately 6.5 km in length selected between the villages of Chacha and Doriya in Pokhran Tesir after soil survey and appropriate consultation with the Rajasthan State Forestry Department. A total of 1,813 firefly diverters will be installed along this stretch. This model has been approved by experts in the Bastard Specialist Group of the International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC).

The name fireflies come from its appearance as they look the fireflies glowing on power lines at night when viewed from a distance.[7] The selected section faces the Pokhran Field Shooting Range, which provides a safe habitat for the Gibbs breeding population outside Jaisalmer's Desert National Park Reserve.

4. Methods

In general Firefly installs in seconds on live lines up to 115 kV by hand, hot stick, or helicopter. They are also safe to use on OPGW lines. Firefly are easy to remove and install as bird activity changes with the season.. The recommended spacing is 30 feet between Firefly diverters.

Currently in India installation of diverters is done by hand with adequate height or with the help of hot sticks for relatively higher altitudes. In both cases the individual is in close proximity to the wires that possess a threat to the worker. When human contact is anticipated the power is cut from the transmission lines to ensure human safety. This results in financial losses in industry within the concerned area.

Moreover, the time consumed in this process is very high. The risks possessed are also high. The government has started a new initiative to introduce the usage of drones in the installation of diverters. This will prove to be more time saving and would possess less risk to human life.

5. Technical Specifications

- Bird Flight Diverter must be dynamic type and consist of warning disc and associated clamps & connectors.
- These diverters may or may not have solar powered LEDs.

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- Dynamic Solar Powered LED Bird Flight Diverters should be prioritized in areas of persistent foggy or dusty weather, low light intensity, and sections of line on migratory bird routes.
- The requirement of solar powered LED may be decided by the utility.
- A bird flight diverter must be able to function efficiently in all weather conditions and maintain excellent physical properties.
- A Bird Flight Diverter (BFD) must have a service life of at least 15 years.
- BFD shall be suitable for installation on live electric cables.

6. Bird Flight Diverter

Warning discs should be provided so that the Bird Flight Diverter can be seen. Warning discs must meet the following conditions:

(a) Glow in the dark. Glow in Dark should remain active for at least 12 hours after exposure to sunlight. If using a glow in the dark decal, it should be laminated and work in all weather conditions.

(b) Have retro reflective surfaces of contrasting colours (any two-colour combination of red, yellow, orange, and white) and sun and moonlight reflectors on both sides; The warning disc is designed to rotate, so the colour change during rotation provides a clear advance warning.

(c) Rocking, rocking or slightly twisting;

(d) Be resistant to all weather conditions;

(e) Be aerodynamically stable so that minimal drag is exerted on the divertor to create swirling and rolling effects in moderate/high wind speeds;

(f) Be made of UV stabilized plastic. Bearing shall be made of stainless steel and should allow free spinning in minimum wind speed of 2 km/hour.

(g) The circular disc has a diameter of at least 150 mm; If the warning disc is square, trapezoidal or any other shape, the minimum length of the arm should not be less than 90 mm and the total area of the warning disc should not be less than 15,000 mm2 (including ventilation openings) .

(h) Have a thickness of at least 3 mm;

(i) There shall be a reflective surface of 3500mm^2 or more on both sides of the warning disc. The glow-in-the-dark area should also not be less than 3500 mm^2.

(j) The weight of the bird deflector shall not exceed 800g. LED type bird deterrents should not weigh more than 1000g.

(k) The length from the connection point of the bird deflector to the end shall not exceed 430mm.

7. Drone

A drone is an unmanned aerial vehicle. Drones are more commonly known as unmanned aerial vehicles (UAVs) or unmanned aerial systems. Essentially, drones are flying robots that can fly remotely or autonomously using software-driven flight plans in embedded systems that work in concert with onboard sensors and a global positioning system (GPS).

UAVs are most commonly associated with the military. They were originally used as anti-aircraft target practice, intelligence gathering and, more controversially, weapons platforms.[8] Drones are now also being used for many civilian tasks such as Search and rescue, surveillance, traffic monitoring, weather monitoring, firefighting, personal use, drone- based photography, videography, agriculture, delivery services [6].

8. How Do Drones Work?

Common Drone Features and Components

A drone has a number of components, including: An electronic speed controller that controls the speed and direction of the motor. air traffic controllers; GPS modules; batteries; antennas; receivers; cameras; sensors such as ultrasonic sensors and collision avoidance sensors. An accelerometer that measures velocity. An altimeter that measures altitude.

Flame Wheel 550 (F550)

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9. Design

Flame Wheel	550 (F550)
Frame Weight	478g
Diagonal Wheelbase	550mm
Take-off Weight	1200g ~ 2400g
Recommended Propeller	10 × 3.8in ; 8 × 4.5in
Recommended Battery	3S~4S LiPo
Recommended Motor	22 × 12mm (Stator size)
Recommended ESC	15A OPTO

10. Problem Statements

Attachment of Bird Diverter

Currently the diverters are attached by sticks manually which time is consuming.

It also possess risk to the worker and hence a more safe and reliable solution is needed. If considering drones their battery life should be taken into Drones have two basic functions: flight mode and navigation.

For a drone to fly, it needs an energy source such as a battery or fuel. There are also rotors, propellers and frames. Drone frames are typically made from lightweight composite materials to reduce weight and increase maneuverability.[9]

Drones require controllers that allow operators to remotely launch, navigate, and land the aircraft. The controller communicates with the drone using radio waves such as Wi-Fi. Consideration hence a fast way to attach these drones is necessary.

Movement Allowance

Free movement of bird diverter along x and y axes and free rotation. Attaching mechanism should not obstruct the movement of the bird diverter.

Available Constraints

Transmission lines form a bulge at the center that might cause the attachments to slide and gather at the center. The diverter should not move from its position because of any external disturbances.

Safety

Spring attached in the attachment mechanism provides the necessary tension required to keep the diverter attached. The detachment process provides an impact that may cause the drone to lose control and get entangled with the transmission power lines.

The propeller of the drone can have impact with the transmission lines causing accident.

Compatibility of Drone

The drone has weight carrying limitations so the mechanism should be within specified limits. The whole setup should be in such a way that it does not disrupt the movement of the drone.

Easy Detachment

The attachment process of drones should be quick and efficient. This requires the attachment to deattach from the drone in a quick and smooth manner.

Brain Storming

Attachment by drones will consume less time and will provide more feasibility in attachment.

The mechanism should be fitted within the shortest time. No external fitting will be required.

Once the drone is in position the attachment should entangle with the wires in such a way that the grip should be very strong.

The diverter should have free movement so applying a ball bearing at its head should give it free movement in all 3 directions. Free movement mostly depends on the position of the BFD with respect to the attachment.

Spring attached should have tension with the required limits. A high tension spring will provide great grip but will result in high impact.

The drone can be attached with an additional mechanism that remains stationary to the drone that can act as guide to the drone. As the lines are at a great height monitoring the drone visually can be very difficult. Guiding setup can prevent drone accidents. Also it will provide sufficient distance of propeller from the transmission lines.

The diverter is a light weight mechanism so the only weight that should be in consideration should be of the attachment mechanism. Polymer of light weight but heat resistant is into consideration. The guiding setup ensures the attachment is further away from the propellers so that they don’t entangle with the transmission lines.

The mechanism should be helpful to hold the attachment firmly so it doesn’t move from its desired position. In our

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discussed mechanism the spring produces an impact force that can be used to detach the mechanism.

11. Solutions

A clamp-like mechanism can be a easy attachment mechanism within the shortest time. The clamping force can be provided by the spring attached to it.

Either torsion spring can be used or tension spring. A breakable material will be placed in between the jaws of the clamp to keep the clamp in tension.

An additional mechanism can be added to the drone that pushes the clamp to close or else a breakable material can be fixed in between the jaws that provide the force needed to keep the spring in tension and once it breaks helps the clamp to hold tightly against the wires.

The extension to attach the BFD is designed in such a way that a specific distance according to the government norms is maintained.

It is attached at the bottom of the mechanism either at the center right below the spring or at either side of the diverter. This will ensure that the mechanism does not interfere with the swinging movement of the BFD which is very important.

A single groove can be made with the dimensions of the wire so that it fits perfectly.

The groove should resemble an oval shape to give more gripping area.

The groves can be padded with rubber that possesses properties like high heat resistivity.

To reduce the impact springs with different tensions are being tested out. The most optimum spring will be selected for the mechanism.

To avoid contact of propeller with the transmission lines 2 type of guiding setup can be designed.

One that can get attached at the center of the drone in the: In the shape of a table with 4 probes at an angle of 75’ with the horizontal in the clockwise direction .The diagonal arm can also be used for guiding the drone towards the power line in a safe manner.

And the other can be attached at 3 alternate arms in an L manner. The vertical part provides necessary height while the horizontal part takes the mechanism away to protect the propellers.

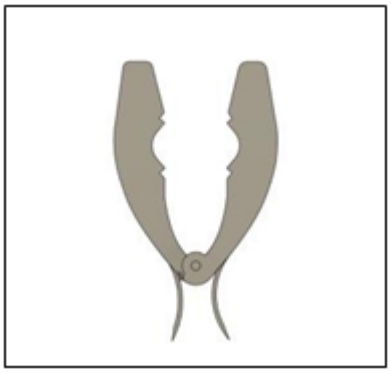
Nitrile rubber a light weight material who has high thermal resistivity can be used for the grooves to avoid slip.

Currently for prototyping PLA is used to provide high accuracy and light weighted.

Press fit mechanism can be provided at the end of the guiding setup. It can hold the mechanism firmly in the jaws to avoid any free movement. An impact force is required to detach any part from the press fit. The impact from spring provides the required force.

12. Selection and Validation

A clamp mechanism will be the most efficient way to attach the BFD in the shortest time available.



Attaching torsional tension spring is easy to operate and keeping it in tension is done by the extended claws on the downside. It helps press the probes of the spring inward to acquire the given tension.

The spring is kept in tension by placing a rod of breakable material in between the jaws. The material can be made porous are can be externally weakened. It is done in such a way that the rod breaks on normal impact.

The guiding mechanism is a Quadra pod structure where either 4 BFDs can be attached on each leg or 2 BFDs on alternate legs depending on the drone capability.

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A press fit is provided at the end of the guiding setup to hold the mechanism firmly. It will also help the flyer the to avoid drone accidents.

Once the BFD is in position the drone is vertically lifted up with speed so that the rod breaks and the clamp closes on the power line. The grip is strengthened by the rubber material provided on the lining on the grooves.

The impact from the tension in the spring helps detach the mechanism from the press fit.

13. Prototyping

Digital manufacturing techniques, also known as 3D printing or additive manufacturing, create physical objects from geometric representations by continuously adding materials. 3D printing technology is a rapidly developing technology.

Manufacturing lead times are significantly reduced, speeding time-to-market for new designs and allowing you to respond more quickly to customer demand.[12]

REFERENCES

[1] Suritha Datta, Azad R Rahamani, Yadvendradev V Jhala. Running out of time? The great Indian bustard Ardeotis nigriceps—status, viability, and conservation strategies (2010).

[2] Wildlife Institute of India 2018 Power-Line Mitigation Measures. Power Line Mitigation to save bustards (2020).

[3] Miguel Ferrer, Virginia Morandini, Ryan Baumbusch, Roberto Muriel, Manuela De Lucas, Cecilia Calabuig. Efficacy of different types of “bird flight diverter” in reducing bird mortality due to collision with transmission power lines (2020).

[4] Monitoring of effectiveness of bird flight diverters in preventing bird mortality from powerline collisions in Slovakia [Marek GÁLIS & Michal ŠEVČÍK]

[5] Chervick T 2004: Firefly bird flapper/diverter testing. https://driveelectric.hu/driveelectricnet_files/Fire - fly%20BirdFlapperLeeKay%20PondsEfficacy.pdf

[6] B. Venkata Mounish Reddy. Potential applications of drone (2021).

[7] The use of ‘flight diverters’ reduces mute swan Cygnus olor collision with power lines at Abberton Reservoir, Essex, England Darren Frost Cambridge Ecology Ltd., Hilton House, 37 Hilton Street, Over, Cambridgeshire CB24 5PU, UK.

[8] Unmanned aerial vehicle https://en.wikipedia.org/

[9] Recent Advances in Unmanned Aerial Vehicles: A Review Faiyaz Ahmed J. C. Mohanta, Anupam Keshari, Pankaj Singh Yadav.

[10] N. Shahrabudin, T.C. Lee, R Ramlan. An Overview on 3D Printing Technology: Technological, Materials, and Applications (2019).

[11] Mohsen Attaran. The rise of 3-D printing: The advantages of additive manufacturing over traditional manufacturing (2017).

[12] The Impact and Application of 3D Printing Technology Thabiso Peter Mpofu, Cephas Mawere, Macdonald Mukosera.

[13] Design of spring https://www.researchgate.net/publication/312317437_Spring_Design

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